FURTHER DEVELOPMENT OF IRON REMOVAL PLANT AND STORAGE

By F. C. Amsbary

In the year 1913, the Champaign and Urbana Water Company installed a gravity filter plant for the purpose of removing the iron content from the well water with which it supplies the twin cities. The iron is present in the raw well water to the extent of about two parts per million.

Papers have been read before this association describing the plant, the methods of operation and some of the difficulties encountered in getting the plant to operate successfully and continuously.

You will recall that considerable difficulty was experienced before efficiency was obtained, the greater difficulty being the fouling of the sand beds due to the tenacious nature of the iron oxide collected on them.

It had been the custom at our plant to use a fire hose on the surface of the filters whenever they became so clogged that they would not last through a fifteen hour run with any degree of efficiency. This seemed to tear the floc loose and clean up the sand bed so that the filters could be used for several weeks again when the same operation had to be repeated.

The benefits resulting from the use of a fire hose upon the filter bed demonstrated the possible applicability of a high pressure wash regularly applied to the top of the bed. Suggestion was made by Mr. W. W. DeBerard during the meeting of this Society in May, 1915, of a high pressure grid placed a few inches above the sand bed while the latter was at rest but which would be submerged in sand when the wash water was applied to the under drains. This method had been tried out at Oakland and found to work in a very efficient manner. Accordingly, during July of 1914 an experimental grid was placed in one of the filters. After six months' trial the effectiveness of this grid was so evident that similar grids were placed in all of the filters.

The grid system as installed for experimental purposes consisted of two parallel manifolds made up of 4-inch nipples, 15 inches long, and 4 x $\frac{3}{4}$ inch crosses. Lengths of ordinary $\frac{3}{4}$ inch galvanized iron pipe, $2\frac{3}{4}$ feet long, capped at the outer end, were screwed into the crosses thus forming the laterals to the grid system. The laterals were perforated on their under surface at 12 inch intervals with $\frac{1}{16}$ inch holes. Perforations were found to clog rapidly so the size of the holes was enlarged to $\frac{1}{8}$ inch and finally to $\frac{3}{16}$ inch.

A fairly even distribution of the wash water is secured. There is approximately one perforation per square foot of filter area. The discharge through the grids is estimated at one-third the discharge through the under drains.

Since all of the grids have been installed at least six months, it can be stated more or less definitely just what has been the advantage of this installation. The quantity of wash water required to wash the filters has been reduced more than one-third. Approximately 25,000 gallons per filter per day are now required where formerly 35,000 gallons per filter per day were required. As to the frequency of washing, when it is necessary the filters can be put through a 24 hour run and still maintain a fair degree of efficiency. Formerly at the end of an 18 hours' run the sand bed would be almost impervious.

Frequent analyses of the effluent show an average iron removal of 95 per cent, the product being very satisfactory to the patrons.

And now comes a chapter in the story of the efforts to improve the quality of the water supply that has given much concern. We were congratulating ourselves on finally succeeding in removing the iron when we began to get complaints from our customers that small red worms had been found in the water. At first we thought this an error, but when a customer brought to our office a bottle of water containing perhaps a dozen live squirming red worms, we immediately began an investigation.

The bottle containing the worms was taken to Dr. Forbes, state entomologist, who immediately classified them as larvae. He assured us they were entirely harmless, in fact when found in water supplies it indicated the water to be of high purity. We were of course considerably relieved and the next customer that complained was assured that he should not be alarmed that we had the authority of Dr. Forbes that they were harmless and their presence in the water proved it of an unusual purity. But he said, "Dr. Forbes and

you be darned. If you expect me to buy water full of worms and *pay* for it, I will refer the matter to the mayor and city council, the State Public Utilities Commission, the board of health and the pound-master."

Several other interviews with irate, worm-hating customers convinced us something would have to be done, somehow Champaign and Urbana water consumers could not reconcile pure water with a worm content. Though in discussing the matter with our patrons we used the word larvae, the word seemed more refined, less vulgar, in every case the patron used the word worm. In fact one man man was impolite enough to call them small snakes.

Somewhat discouraged we again called on Dr. Forbes and asked him what could be done to be rid of the pests. It was suggested that fish or frogs be put into the reservoir, that they would feed upon the larvae and a system of screens could be installed to prevent the fish or frogs from finding their way into the water pitchers about town.

This did not appeal to us, for we did not care to turn our reservoirs into fish or frog ponds. Dr. Forbes informed us that a period of six weeks was necessary for the evolution of the eggs to the winged midge. We then decided to clean our filtered water basin once a month and break up the breeding ground of the larvae.

Dr. Forbes was asked to write an article for the paper explaining the matter from a scientific standpoint which would tend to allay the fears of our patrons, who were already blaming us for all the sickness in town, until we had time to carry out our plans.

This he did. Dr. Forbes' article on this subject published in the *Urbana Courier* was as follows:

Dr. Forbes Describes the Larvae

Nearly every one must have noticed in spring and fall, swarms of small midges stationary in the air at a little distance above the ground, especially in the neighborhood of ponds or water courses, every member of the company flying actively around and about and in and out, but the swarm as a whole curiously motionless or perhaps rising and falling slowly with the wind. These little midges, often called harlequin flies in England, are really executing an intricate aerial dance, each swarm being a dancing party of males, into which an excited female will every once in a while make a sudden dash, seizing upon an unreluctant male and flying away with him for a mate. Later she dips down to the surface of the stream or pool and lays a rope of delicate eggs held together in strings by a gelatinous envelope which immediately swells

up when wet into an abundant, transparent mucilage, within which the eggs are held imbedded.

From these transparent larvae presently hatch, and sink to the bottom, where they lie buried in the mud and sediment, feeding on particles of vegetation and other organic debris which it contains. They are so abundant in our natural waters that they are an important element in the food of nearly all our fishes, and I have myself taken them in quantity from the stomachs of black bass, white bass, perch, sunfish, crapple, minnows, suckers, buffalo fish, dogfish, spoonbills, etc., more than sixty species of Illinois fishes in all which I know to feed upon them. We have immense collections of these little larvae from all kinds of Illinois waters; and a specialist has been at work for months at my laboratory unraveling their classification, describing new species, rearing larvae to the winged midge, and helping to make us acquainted with this important complex group. Some kinds of these larvae are colorless and nearly transparent, others are white, and a good many are red, from which fact they have received the common name of "blood worms." They are not worms, however, but insect larvae, as I have just explained.

They are entirely harmless in every stage, the larvae helping to keep the water clean by devouring substances which might otherwise decay, and the midges, notwithstanding their mosquito-like appearance, being unable as well as indisposed to bite. They become troublesome only to those who do not understand their nature when they appear in our water supply, as they sometimes do, whether this comes from springs or other superficial sources, or is exposed to the air for a time in an open reservoir. They are occasionally seen in the Urbana tapwater, although so rarely that I have never seen them there myself and I am writing this note merely to assure the people of the town that they are not in the least injurious or dangerous and that their occasional appearance here means nothing at all except that the female harlequinfly has deposited some eggs in the water works reservoir. Mr. Malloch, of my staff, has reared and identified our water works larva, and finds it identical with a widespread species occurring abundantly in waters of various descriptions in nearly all parts of the state.

(Signed) STEPHEN A. FORBES,
State Entomologist.

To clean the filtered water basin it was found necessary to pump unfiltered water into town for a couple of days, so we built another filtered water basin and connected the two together with an 18 inch pipe and so arranging the pipe connections that we are able to deliver filtered water into either one or both. Also, we laid a new 18 inch suction line by—passing either basin so that with the present arrangement, we can clean either basin without interfering with the service.

This new basin was completed in July and we have cleaned the basins a number of times and each time finding fewer of the larvae present in the basins. We feel that we have broken up the larvae nest. The last time the basins were cleaned no signs of larvae could be found.

DISCUSSION

MR. W. D. GERBER: Mr. Amsbary's paper brings out very forcibly again the fact that here at the state university we have men of special training, experts in their respective lines, who are ready and anxious to assist in the solving of any unusual problem. While we have all left our student days behind, still we are each day working along on our post graduate work, and when we find a problem that is out of the ordinary we should realize that the university is still our instructor and turn to her at once for help. Some of us have learned to take advantage of these resources of the university, but it is to be regretted that more of us have not done so, and until we all do we are denying her the opportunity to supply the great service for which she was created.